

What can your height tell about you: educational level and body height in Portuguese young males  
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Changes in body height in a population may be regarded as an indicator of changes in the standard of living. A secular increase in body height, parallel with increasing affluence, have been reported from numerous industrialized countries. Conversely, low body height has been associated with a variety of adverse health outcomes, including total mortality, cardiovascular morbidity and mortality, and mortality from obstructive lung diseases.

In Portugal, mean height of 18-year-old-males has increased 8.99 cm between 1904 and 1998. This positive trend must be related to the general improvement in the population's standard living conditions. From the 1960s until the 1990s post-neonatal mortality rate decreased from 46.7 to 3.34; life expectancy at birth increased from 60.7 years to 70.2 years and food intake increased from 2671 to 3577 calorie/day.

Despite this positive trend, great social difference still exists in Portugal. The aim of the present study was to investigate the relation between adult body height and the educational level achieved in a large sample (N = 741 476) of Portuguese males aged between 21-25 years. Four educational levels were considered: primary school, secondary incomplete, secondary and university.

Strong, positive relations were found between body height and the educational level achieved. The difference between highest (university) and lowest (primary) educational level was 4.08 cm. Males with a university level of education have a mean height (174.98 cm) 2.78 cm higher than the mean height of the total Portuguese population (172.2 cm).

The difference between the lowest educational level and the highest is probably related to conditions during growth through nutrition and health care system provided by each family.

Does dental microwear analysis confirm or reject dietary predictions based on functional dental morphology? A comparative test case for fossil primates utilizing the middle Miocene primates from Maboko Island, Kenya. A.K. PALMER, Department of Anthropology, University of Texas, Austin, TX 78712 and B.R. BENEFIT and M.L. MCCROSSIN, Department of Anthropology, Southern Illinois University, Carbondale, IL 62901.

In the past several decades, studies of functional dental morphology (e.g. Kay, 1975, 1977; Hylander, 1977) and dental microwear analysis (DMA) (e.g. Shkurkin et al., 1975; Walker et al., 1978) have emerged as quantitative tools that have been used to predict the dietary preferences of fossil primates. While each technique is different, do they produce similar predictions of dietary preference when applied to the same fossil sample? Five species of fossil primates (*Kenyapithecus africanus*, *Mabokopithecus clarki*,

*M. pickfordi*, *Simiolus leakeyorum*, and *Victoriapithecus macinnesi*) from the middle Miocene fossil locality of Maboko Island, Kenya were chosen to test this hypothesis.

Standard DMA (Palmer et al., 1998) and four established measures of functional dental morphology (shear crest length [SUMS/L], the height of the metaconid above the occlusal basin [NHNR], degree of crown flare below the mesial cusps [FL], and degree of crown elongation [L/MW]) (Benefit, 1993; 1994; Benefit et al., 1998) were performed on the M<sub>2</sub>s of the five primate species from Maboko. All the functional measurements (e.g. NHNR) indicate a dietary continuum with *Simiolus* (130) being the most folivorous followed respectively by the oreopithecids (86), *Victoriapithecus* (74), and *Kenyapithecus* (71). DMA results indicate that the percentage of M<sub>2</sub>s phase II facet scratch features, which denotes the degree of folivory, is similar with *Kenyapithecus* exhibiting the lowest percentage of scratch features (59), followed by *Victoriapithecus* (68), *M. clarki* (85), *M. pickfordi* (91), and *Simiolus* (92).

For the primates studied, both methods indicate the same categories of frugivory or folivory for each species. However, certain features of DMA (pit width, scratch length and width) were able to discern finer trophic distinctions within each of these larger dietary divisions. As a result, DMA is particularly useful when attempting to assess resource and niche partitioning within a particular community structure and in exploring the individual species food preferences within those broader dietary categories.

Inter- and intraspecific cranial variation of Asian colobines. R.L. PAN, Department of Anatomy and Human Biology, The University of Western Australia, Nedlands, Perth, Western Australia, 6907, Australia and Kunming Institute of Zoology, The Chinese Academy of Sciences, P. R. China.

In order to reveal cranial variation in Asian colobine monkeys, fifteen taxa of Asian colobines including odd-nosed species (golden monkey, douc langur and proboscis) and leaf monkeys (*Presbytis* and *Semnopithecus*) were analyzed using morphometric methods. Patterns of inter- and intraspecific variation were studied based on the raw data and residuals, separately. Four species clusters were found in each data set: 1) *Rhinopithecus* and *Pygathrix*; 2) *Nasalis*; 3) *Presbytis* and 4) *Semnopithecus*. These findings tentatively confirm the hypothesis about phyletic relationships among Asian colobines proposed by Delson (1994). That is, separate stocks: *Rhinopithecus*-*Pygathrix*, *Nasalis*, *Presbytis* and *Semnopithecus* might have evolved from the same ancestor in the Middle Pliocene. The division between *Presbytis* and *Semnopithecus* might have occurred a little later in the Late Pliocene. Even though golden monkeys and douc langurs are included in the same cluster, the latter shows some variation from the former. Douc langurs are also characterized by lesser differences between the sexes. This supports the concept that they are different genera (Jablonski and Peng, 1993; Jablonski, 1998) rather than two subgenera of one genus (Groves, 1970, Nowak and Paradiso, 1983). Because of a great variety in inter- and intraspecific variation that might be related to recent divergences between species, it is rather difficult, on these

data, to draw a line between leaf monkey genera as proposed by some researchers, except for the separation of *Semnopithecus entellus* from the other species. This study thus supports the arrangement of two genera in leaf monkeys: *Presbytis* and *Semnopithecus*, as proposed by Delson (1994). Three variables, biporionic width (the distance between the most lateral points on the external auditory canals), calvarial length (the distance from glabella to the tip of the occipital protuberance) and postorbital constriction (the minimum width behind the orbits), seem to be especially important in cranial variation analysis of Asian colobines.

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Sex and age class differences in the foraging behavior of free-ranging white-faced capuchins (*Cebus capucinus*) in Costa Rica. M. A. PANGER, The George Washington University, 20052.

The diet and foraging behavior of capuchins (*Cebus* spp.) vary significantly, both intra- and interspecifically. Determining how age/sex class differences influence this variability requires comparative data across research sites. During an 11-month study, I examined the foraging behavior of free-ranging capuchins at a previously unstudied *Cebus* site, and investigated the relationship between age/sex class and variability in foraging behavior.

Foraging data were collected on three troops of white-faced capuchins (*Cebus capucinus*) at Palo Verde, Costa Rica, using focal animal sampling techniques. During focal samples, data pertaining to substrate use, food processing and acquisition behaviors, and type of food ingested (i.e., animal or plant matter) were collected.

The results indicate that adult males and females differ in several aspects of their foraging behavior: 1) males spend a greater percent of total eating time eating animal prey (primarily insects); and, 2) males and females differ in substrate use (i.e., males spend more time on the ground and lower in the trees than females). Aspect (1) is correlated with differential rates of behaviors associated with catching insects (i.e., males exhibit higher rates of grab, peel bark, probe, and unroll leaves). Females, however, show higher rates of "tap" (which is often used to search for insect prey). When comparing juveniles to adults, juveniles spend more time eating and are overall more "active" than adults (i.e., they exhibit higher rates of break branch, clasp, pounce, and unroll). The juvenile substrate-use pattern resembles the adult female pattern.

These results are similar to results reported from other *Cebus* sites. This indicates that, amid the variability in *Cebus* foraging behavior, there are recognizable patterns. The possible reasons for the differences seen in the foraging behavior across age/sex classes will be discussed.

Preliminary light microscopic study of cortical synapses in the male olive baboon (*Papio hamadryas anubis*). PARK PB<sup>1</sup>, NUÑEZ JL<sup>3</sup>, AND JURASKA JM<sup>2,3</sup>. University of Illinois, <sup>1</sup>Department of Anthropology, <sup>2</sup>Department of Psychology, and <sup>3</sup>Neuroscience Program

Quantification of the cellular and ultrastructural components involved in neural growth provides an empirical basis from which to evaluate the functional and evolutionary significance of changes in brain size. Of particular interest are changes involving the formation and modification of synapses in the brain. This study explores the application of immunochemistry and light microscopic techniques in the quantification of cortical synapses in the male olive baboon.

Our sample consists of seven male baboons between 700-900 days of age. We examine frontal (FCA), primary somatosensory (PD), and primary visual (OC) cortical regions. Sections stained for synapses are sliced at 15  $\mu$ m. Presynaptic vesicle membrane proteins are labeled with a synaptic vesicle marker that has been used as an indicator of mature synapses. Additionally, 60  $\mu$ m microtome sections are taken and stained for both cell bodies and myelin. From these sections volume estimates are determined for each of the three regions sampled. The density times the volume of a region are used to determine total number of synapses within a region.

Our results demonstrate that light microscope methods can be effectively applied to quantitative studies of synapse number. This rapid and relatively inexpensive technique allows greater numbers of regions and individuals to be sampled. Application of this type of study to questions regarding changes in synapses between age groups, sexes, and species may eventually provide a detailed cellular-level understanding of neural differences within and between these classes.

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High-resolution admixture map of African Americans living in South Carolina. E.J. PARRA, K. HIESTER, G. ARGYROPOULOS, W.T. GARVEY, R.A. KITTLES, N. SYLVESTER, D. PARRISH-GAUSE, I. KAMBOH, R.E. FERRELL and M.D. SHRIVER. Department of Anthropology, Penn State University, University Park, PA 16802.

The determination of the extent of European admixture and the dynamics of the admixture process in African-American populations is of great anthropological, historical and epidemiological interest. Here, we present data on admixture proportions in six different African-American populations from South Carolina: the Gullah-speaking sea islanders living in coastal South Carolina, four different counties in the Charleston area, and Columbia, the State capital, located in central South Carolina. The port of

Charleston received a large proportion of the slaves imported to the US during the slave-trade (more than 120,000 people), and the population of African ancestry has constituted a significant proportion of the global population in this area. In order to characterize the amount of gene flow, we have typed ten informative markers showing high levels of allele frequency differential between the parental populations. The results of the study indicate, in accordance with previous historical, cultural and anthropological evidence, a very low European admixture in the Gullah sea islanders ( $m=3.5\% \pm 1\%$ ). The proportion of European genes is higher in the Charleston area ( $m$  ranging between  $9.7\% \pm 1.8\%$  and  $13.8\% \pm 1.8\%$ ), and the highest values are observed in Columbia ( $m=17.3\% \pm 3.3\%$ ). We have also studied the pattern of pair-wise associations between the 10 markers in the sample from the 4 adjacent counties in the Charleston area ( $N=548$ ). A high level of linkage disequilibrium was observed between two markers located 22 cM apart (FY and AT3), but a significant association was also detected in 4 of the 8 unlinked marker comparisons, suggesting the existence of a significant substructure in this population. These results are discussed in terms of research in genetic epidemiology and the applicability of Admixture Mapping methods in studies of complex diseases like obesity, hypertension and diabetes.

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Intraspecific Variation in Positional Behavior among Three Captive Species of Lemur (*Propithecus verreauxi coquerelli*, *Varecia variegata variegata* and *Eulemur coronatus*). M.S. PASIN, Department of Anthropology, Northern Illinois University, DeKalb, IL 60115 and L.L. TAYLOR, Department of Anthropology, University of Miami, Miami, FL 33125.

In most studies of primate positional behavior, observations are usually lumped together since they cannot be attributed to marked individuals. Thus, species have traditionally been characterized by a single proportion that prohibits estimation of the variability around some measure of central tendency. We report on the degree of intraspecific variation in locomotor/postural behavior in three species of lemurs (*Propithecus verreauxi coquerelli*, *Varecia variegata variegata* and *Eulemur coronatus*) housed at the Duke University Primate Center. Each species is represented by one group which ranges freely in a multi-acre forest and another housed in a large outdoor cage. Each group contains at least one aged animal ( $>18$  years old). Observations were recorded on known individuals utilizing continuous focal animal sampling (bouts). These data describe the variability in positional behavior within each species and tests the effects of age and enclosure type on the variability observed.

The degree of variation in positional behavior remains relatively constant within each species. Leaping and bipedalism are the most variable locomotor categories in *Propithecus* (range: 37.9%-61.2% and 7.0%-34.1%), and quadruped-

alism the least variable (range: 0.96%-9.7%). *Eulemur* and *Varecia* vary the most in leaping and quadrupedalism categories and least in suspension. Controlling for age reveals an effect only within *Propithecus*. Aged individuals of *Propithecus* contribute considerably to the variation within quadrupedalism, bipedalism and suspension categories; however, leaping and climbing are not affected by age. Intraspecific variation in positional behavior is affected by enclosure type. Locomotor behavior in caged *Varecia* varies considerably more than the free-ranging group.

Reliable estimates of variation in positional behavior within primate species are crucial when attempting to correlate movement with anatomy or in understanding the relationships between habitat and morphology.

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Phylogenetic relationships within the lemur family Cheirogaleidae from mtDNA sequence analyses.

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Currently the Cheirogaleidae are classified into five genera: *Allocebus*, *Cheirogaleus*, *Microcebus*, *Mirza*, and *Phaner*, whose nodal relationships remain contentious. Depending on the evidence used, conflicting conclusions regarding taxonomic status and phylogenetic position have been reached for *Mirza coquereli*. Also the phylogenetic position of *Allocebus* requires clarification. A further goal of this study was to verify the taxonomic status of the recently discovered *M. ravelobensis*, which lives sympatrically with *M. murinus*, as a separate species and to determine its phylogenetic position within the genus *Microcebus*.

In the present study, ~2.4 Kb of mitochondrial DNA sequence data from a fragment of the COIII gene, and complete ND3, ND4L, ND4 genes alongside 5 tRNAs was used to clarify phylogenetic relationships among Cheirogaleidae. Samples were collected from 1 *A. trichotis*, 3 *C. major*, 3 *C. medius*, 6 *M. murinus*, 4 *M. ravelobensis*, 6 *M. rufus*, and 3 *M. coquereli*. Unfortunately samples of the genus *Phaner* were not obtained. Three *Daubentonia madagascariensis* were sequenced to provide an appropriate outgroup. Sequences were analysed with PAUP 4.0b2 using maximum parsimony, neighbor-joining and maximum likelihood methods.

In all analyses the relationships among the species or genera remain consistent. *Mirza* and *Microcebus* form a clade which is the nearest sister group to *Allocebus*. The most basal clade is represented by *C. major* and *C. medius*. *M. ravelobensis* and *M. rufus* form a subclade within *Microcebus*. Those arrangements are strongly supported by bootstrap and jackknife analyses. Based on pairwise distance comparisons, tree topology, branch lengths and bootstrap/jackknife values we conclude that *Mirza coquereli* represents a distinct genus, and that *M. ravelobensis* indeed represents a distinct species.

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# Longitudinal growth data from Malian adolescent girls: Implications for catch-up growth.

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Cross-sectional data previously has indicated poor growth and development among adolescent girls in Mali. These data have shown that Malian girls are shorter and lighter than their U.S. female counterparts. Many studies suggest that this evidence of poor growth and development is due to a combination of poor nutritional intake, high-energy expenditure, and poor access to healthcare.

However, at adolescence, individuals rarely follow a standard pattern of growth due to different biological timetables and expressions of pubertal growth. Thus while cross-sectional studies can be helpful in examining the overall nutritional status of adolescent girls, longitudinal studies can be particularly helpful in examining the *velocity* of growth. Only by examining the velocity of growth can researchers recognize developmental patterns such as catch-up growth. This study examines the growth rates of Malian girls over a 6-month period.

Anthropometric data were collected from a total of 1045 adolescent girls aged 10 to 17 years. Height and weight data were collected twice from the Segou Coura community in the city of Segou and the Dioro Arrondissement from 1996 to 1997.

Both the height and weight velocity data showed patterns of delayed growth rates when compared with American girls. Although Malian girls are similar to American girls in that they tend to reach their peak height velocity at age 12, the Malian girls demonstrated a much longer growth spurt than American girls. This evidence of greater height velocity may be an indication of compensatory gain, or catch-up growth, and is partially supported from the cross-sectional data. While these Malian data do not show much evidence that certain stressors are relieved during adolescence, only more extensive longitudinal data can more fairly examine the issue.

Postcranial differences between Neandertals and cold-adapted recent humans. O. M. PEARSON, Department of Anthropology, University of New Mexico, Albuquerque, NM 87131-1086.

Comparisons between Neandertals and recent human postcranial skeletons are complicated by the Neandertals' extremely stocky, cold-adapted physique. Climatic adaptations provide one of the most significant sources of postcranial variation between recent populations, thus the Neandertal physique assures that they will appear distinct from most recent groups. This report compares Neandertals with cold-adapted recent humans (Inuit and Sami) to control for the effects of climatic adaptations.

A suite of 122 measurements were taken on skeletons of Neandertals (16 males, 6 females), Alaskan Inuit (25 females, 25 males), and Norwegian Sami (25 females, 34 males). The measurements captured the lengths, midshaft dimensions, and epiphyseal size of the major long bones,

selected hand and foot bones, and limb girdles. T-tests contrasted the Neandertals against same-sex Sami and Inuit samples to find distinctive traits. The results were similar for male and female Neandertals. Due to sample size, comparisons among males produced clearer results.

Relative to the Inuit and Sami, Neandertal males have similar long bone lengths, but somewhat longer forearms. Neandertals have a comparatively massive proximal femur with a large head and a long, stout neck. Neandertal femoral and tibial shafts are comparatively thick, but their arm and forearm bones are sometimes more gracile than those of the Sami and Inuit. Neandertals have remarkably large hands, long clavicles, and wide scapulae relative to the Sami and Inuit. Many of the unusual aspects of Neandertal skeletal anatomy readily distinguish them from modern Arctic populations and do not appear to be cold adaptations. Controlling for the influence of climate does little to diminish the distinctiveness of Neandertals relative to recent humans.

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**Differences in the brainstem facial motor nucleus in *Erythrocebus patas* and *Macaca fascicularis*: A qualitative and morphometric analysis.** TA PEBURN<sup>1,2</sup>, KA SHERIDAN<sup>4</sup>, NM KHECK<sup>3</sup>, PR HOF<sup>3,4,1,2</sup>, J GASDOGAS<sup>5</sup>, J ERWIN<sup>6</sup> and PJ GANNON<sup>1,3,4,5</sup>, <sup>1</sup>NYCEP; <sup>2</sup>CUNY Graduate School; Depts. of <sup>3</sup>Otolaryngology and <sup>4</sup>Neurobiology, Mount Sinai School of Medicine, NY; <sup>5</sup>NYU; <sup>6</sup>Diagnon Corp, MD.

The gestural-visual mode of communication in non-human primates is largely controlled by the facial musculature. Facial gestures are critical to, and likely the main channel that subserves, proximal inter-individual social interactions. The musculo-facial complex is also involved with other functions such as food processing and vocalization. Facial motoneurons (MN) are directly innervated by the cerebral cortex, unlike MN of nucleus ambiguus, which innervate the larynx (vocalization). This direct cortical control of the face represents a major adaptive shift in fine motor control that is first evident in Old World Monkeys (OWM). Our study tested the hypothesis that communication based differences in functional utilization of the facial musculature in two OWM are manifest in the organization of the brainstem facial motor nucleus (N-VII).

Perfusion fixed brains of *E. patas* (n=3) and *M. fascicularis* (n=3) were used for this study. Coronal sections (30µm) of the brainstem facial motor nucleus region were Nissl stained with Cresyl violet for histological analysis. Based on a retrograde tracing study of the facial motor nucleus in *M. fascicularis* (Welt and Abbs, 1990), we conducted a comparative anatomical analysis to characterize the location and distribution of multiple subnuclei within N-VII in *M. fascicularis* and the previously uncharacterized *E. patas*. Volumes of N-VII were derived from area measurements of sections via the light-microscope ocular micro-grid method and correlated to body size.

Motoneurons within N-VII of *M. fascicularis* form a compact cell column that is well organized with regard to boundaries of distinct subnuclei related to sub-units of the facial musculature. In contrast, the configuration of motoneurons within N-VII of the comparatively less facially expressive *E. patas* was more diffuse with a wide separation of cells and less defined organization of sub-nuclei. Furthermore, relative to body size, *M. fascicularis* exhibited significantly (p<0.001) larger facial nucleus volumes, even though MN are more compactly distributed. We are currently quantifying cell density and cell number within a larger sample size in order to characterize



further how N-VII is organized in these OWM. These studies may offer insight into the sequence of evolutionary events that gave rise to polymodal communication in catarrhines.

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Adjustments to agriculture in early farming communities of northeast China. E. A. PECHENKINA and R. A. BENFER, JR. University of Missouri-Columbia, Columbia, MO 65211

The general tendency towards health deterioration with agriculture presents a conundrum: why would agriculture be adopted in the first place? It may be that health improved with very early agriculture; when health later deteriorated, the achieved population size became too large to permit a return to foraging. We test this proposition with human skeletal and dental materials from northeastern China. The remains of 133 individuals from the Weinan Beiliu (6,390 BP), Linton Jiangzhai (4,890- 5,970 BP), Weinan Shijia (4,860 BP) and Kangjia (4,000 BP) sites in northeastern China were studied. Dental wear, whether measured by crown height or the difference between Scott scores in M2 and M1, did not vary significantly among the sites. Carious frequencies tend to increase over time from 1.2% in the early Linton Jiangzhai (LGZ) materials, to 2.1% in its later component, to 4.2% at Weinan Shijia (WS) to 21.7% in the most recent collection, Kangjia (LKJ). The only exception to the trend is Weinan Beilu which produced a frequency of 10.3% carious teeth in seven old women.

Cases of moderate porotic hyperostosis increase from 0% at LGZ to 2.6% at WS to 37.5% in LKJ. Cribra orbitalia is also significantly higher at the late LKJ site (43.0%) than in earlier WS (2.8%) and LKJ (18.5%). Limb bone lengths, measured as average Z-scores, diminish for both sexes over time, but the differences are significant only in LKJ males, due to a decrease in sexual dimorphism. Incidences of cranial trauma, an indirect indicator of violence, also increased at LKJ.

Taken together, these indicators suggest that health began to deteriorate about 4,000 years ago, long after the introduction of agriculture, not as a direct consequence of adoption of agriculture, but possibly as a consequence of increased population density.

De Tuin: palaeodemography and life history on a 19<sup>th</sup> century mission station in the Northern Cape Province, South Africa. T.R. Peckmann, Dept. of Anatomy & Cell Biology, University of Cape Town Medical School, South Africa, 7925.

De Tuin was a mission station to the "Basters", between 1861 and 1868, whose

descendants currently live in Rehoboth in Namibia. Although it is known that De Tuin had a substantial community at that time, because of the availability of water in the otherwise desert environment it attracted other groups, San, Khoikhoi, and Bantu speaking peoples (Von Rohden 1888).

So far, all of the individuals excavated at De Tuin have been children, all under the age of 10 years at death, many under the age of 5 years at death. All of the skeletons have been found in association with coffin wood and nails. Despite the historical record, it is still difficult to secure a direct association of the graves with the Baster community. The reason why so many children are represented is still unknown, but the biological analysis may help with the mystery of the death patterning.

To illustrate the bioarchaeology of the individuals within De Tuin the following features are analysed, demography, growth, activity patterns, and paleopathology.

One of the biggest obstacles in creating a demographic model of disease patterning at this site is the estimation of sex of juveniles. With help of the Paternity Clinic at UCT, sex is being identified by DNA analysis on the bones of these individuals.

Variation in patterns of bone modification at La Quemada (AD 600-900). V.R. PEREZ, Department of Anthropology, University of Massachusetts Amherst, MA 01003; D.L. MARTIN, School of Natural Science, Hampshire College, Amherst, MA 01002; and B.A. NELSON, Department of Anthropology, Box 827402, Arizona State University, Tempe, AZ 85287-2402.

La Quemada is a large ceremonial complex located in northern Mexico. The primary growth and occupation of the site occurred during the Epiclassic Period (AD 600-900). Throughout the site, a wide variety of bone deposits were retrieved, many of which demonstrated excessive modification in the form of perimortem breakage, cutmarks, reduction in size and shape, and burning.

This project focused on cutmark morphology and its relationship to other kinds of processing and modification in five bone deposits from distinctive locations on one of the many terraces associated with the complex. Cutmark morphology was examined using a

macroscopic and microscopic analysis. Hypotheses about types of tools used to make the cutmarks were tested against the findings. Cutmarks were also examined with respect to other patterns of breakage and reduction to deduce the behaviors used in the processing of the human remains.

The results show that different processing techniques including different tool types were used that distinguish the function that the human remains played in different settings across the terrace. This type of fine-grained analysis of perimortem changes in bones permits a more nuanced analysis of the kinds of ways that human remains may be used in a variety of ceremonial, cultural, mortuary and ritual contexts.

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**The microevolutionary force of genetic drift in black lion tamarin (*L. chrysopygus*) populations.** B.M. PEREZ-SWEENEY<sup>1</sup>, C. VALLADARES-PADUA<sup>2</sup>, D.J. MELNICK<sup>1</sup>. <sup>1</sup>Anthropology Department, Columbia University, New York, NY 10027, <sup>2</sup>University of Brasilia, P.O. Box 04357, 70919-970 Brasilia DF Brazil.

Genetic drift is considered to be an influential microevolutionary force in small, isolated populations and is expected to affect the genetic structure of fragmented populations. We examined the degree to which fragmentation affects genetics in black lion tamarin (*Leontopithecus chrysopygus*) populations in the state of São Paulo, Brazil. These primates provide a unique opportunity for such a study because (1) most of the forest fragments in which they reside were created simultaneously to their present sizes approximately 46 years ago (land managers, pers. comm.), (2) the size of the forest fragments are well known and significantly different, and (3) one large forest fragment (238 Km<sup>2</sup>) is present and available to use as a base line from which to perform comparative studies.

We analyzed both microsatellite loci and sequences from the mitochondrial D-loop of eighty individuals distributed among five populations. The microsatellite loci include designed species-specific primer sets developed for this study from screened *Leontopithecus* cloned DNA.

The genetic signatures of recent fragmentation, through comparisons of several loci (haploid and diploid), significantly adds to what we know about the effects of recent fragmentation on the distribution of variation within and among isolated primate populations. By holding time of isolation constant across all fragments, we have been able to examine how fragment and population size are correlated with levels of genetic diversity and degrees of divergence among the isolates. This study is one of the first to closely examine how fragmentation affects primate population genetic structure.

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**Discerning admixture dynamics: Two models.** C.L. PFAFF, E.J. PARRA and M.D. SHRIVER, Department of Anthropology, Pennsylvania State University, University Park, PA 16802.

Admixture between genetically distinct populations can create non-random allelic associations (linkage disequilibrium). Here we show that the observed levels of linkage disequilibrium between linked and unlinked loci can be used to discern whether admixture occurred quickly and was followed by isolation of the hybrid population (Hybrid Isolation model), or whether gene flow continued through many generations (Continuous Gene Flow model). We have evaluated these two models using both simulated and real data. We have written a simulation program that examines the power of a population survey study to detect linkage disequilibrium between a marker and a disease allele under the two different admixture models. Our results show that the highest powers are achieved under the HI model, with an average power of 0.998 (recombination fraction( $\theta$ ) = 0.1%). In contrast, the average power for the CGF model is only 0.895 ( $\theta$  = 0.1%). Additionally, the CGF model shows associations for >60% of unlinked loci ( $\theta$  = 50%), indicating that substructure can be generated by continual gene flow and result in many false positives. Results from two Southeastern African-American populations, in which more than 500 individuals were analyzed for ten informative markers, closely resemble the simulation patterns obtained under the CGF model. As expected, strong association was detected between two markers located 22 cM apart (FY and AT3). Additionally, 11 of 16 comparisons of pairs of unlinked markers also showed significant associations. This result clearly indicates substantial genetic substructure in Southeastern African-American populations, which is to be expected under the CGF model of admixture. Thus, as efforts are made to use these populations for mapping complex diseases and traits, methods should be used which can control for this substructure.

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**The histological development of cortical bone in juveniles from Spitalfields, a known-age sample.** S.PFEIFFER, Anthropology, U of Toronto, Toronto, Ontario, M5S 3G3, and L.DIXON, Human Biology & Nutr Sci, U of Guelph, Guelph, Ontario, N1G 2W1.

The development of cortical bone in growing humans may be used for estimating age at death from fragmentary remains, if the patterns are definable and predictable. Undecalcified thin sections from mid-thoracic rib samples, representing each of the 17 known age juveniles (8M, 9F) from the Spitalfields population (18<sup>th</sup> C. Huguenots, London, England; Molleson & Cox 1993), were histologically characterized. Five

categories of cortical bone were observed: woven bone, primary bone in the form of lamellar, plexiform and osteonal, and secondary osteonal bone. When considered from birth to 19 years, the samples show a general progression from woven bone to primary bone, with secondary bone added at maturity. There is evidence of drift occurring after two years of age. Primary lamellar bone exists throughout development, woven bone is a hallmark of newborns and is rare after the age of two years. During periods of rapid growth (0-2 and 14-16 years), the number of primary osteons increases and plexiform bone is present. The cortical bone patterns in two Spitalfields samples, a boy of 7 and a girl of 15, are inconsistent with the general patterns. Their different morphologies may be due to delayed and enhanced development, respectively. The correspondence of tissue patterns with growth patterns may allow future workers to extrapolate information about the developmental status of juveniles at time of death.

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Social stigma, disease, and death in two New York county institutions. S.M. PHILLIPS, Burial Sites Preservation Program, State Historical Society of Wisconsin, Madison, WI 53706

This study examines evidence of social stigmatization in the skeletal record of two nineteenth century county institutions. Previous bioarchaeological studies of nineteenth century New England report aberrant mortuary practices for individuals stricken with tuberculosis. Moreover, historians explain that western society stigmatized sufferers of numerous diseases including syphilis, mental illness, leprosy, and plague (among others). To date, bioarchaeologists have not tested for connections between paleopathological conditions and atypical mortuary practices as possible evidence of social stigma.

The materials for this analysis include the Oneida Asylum skeletal sample (n=100) and the Albany Almshouse skeletal sample (n=40). In addition, archaeological field excavation records and historical documentary records for both institutions were examined. Standard cranial and pelvic ageing and sexing methodologies were utilized in the demographic analysis. Paleopathological analysis followed differential diagnosis protocols. And, the historical method was used to critically examine the documentary materials.

The findings of this study indicate certain paleopathological lesions are linked with unusual mortuary behaviors in nineteenth century North America. In addition, the historical documents reveal that diet, therapeutics, and quality of medical care were also subject to stigmatized concepts of disease in the case studies. The existing historiography and bioarchaeological literature shed little light on the care, experiences, and ultimate disposition of individuals stricken with "vulgar" diseases. A goal of this

study is to expand the potential of paleopathological data to include a better understanding of the social consequences of disease.

This work was supported with a Doctoral Fellowship from the University at Albany, SUNY, a Research Associate appointment at the New York State Museum, a Research Residency at the New York State Library, and professional development support from the State Historical Society of Wisconsin.

Postsacrificial processing of the human body in some prehispanic skeletal samples from Mexico. C. Piñón and J. Mansilla, DAF-INAH, Reforma y Gandhi s/n, Mexico 11560.

The taphonomic analysis of several skeletal samples from Mexico has let us determine that there existed a series of complex rituals affecting the bodies after the human sacrifice. These manipulations resulted in the evidence of cultural taphonomic alterations on the surface of the bones such as cut marks, scraping, percussions, intentional breakage, perforation and thermic alterations, among others. The observation and registration of these alterations form different patterns. We propose that these patterns let us determine the actions that caused them. Based on the study of several skeletal samples from different regions of Mexico, we have been able to conclude that these actions included the skinning, defleshing, dismembering, butchering and thermic exposure of the bodies.

We will show which of the different alterations is present in each ritual action.

These analysis are very important as the rituals following the human sacrifice varied through time and space, and in this way we are able to determine their changes.

Seasonality, Mobility, and the Division of Labor across the EUP/LUP Transition. A.PIKE-TAY and L.L.JOHNSON, Department of Anthropology, Vassar College, Poughkeepsie, NY 12604.

Recent data regarding season-of-and age-at-death of large game from Franco-Cantabrian EUP, LUP and Epi-Palaeolithic sites is considered along with evidence for settlement and technological change. Trends seen suggest increased mobility (on the part of task groups; not the entire camp) and territoriality, as well as an increase in catchment area, allowing for longer stays at sites. These trends hold

implications for: 1) "true" home bases where the young, injured and elderly can reside, and to which collectors and hunters return; 2) lowered infant mortality; 3) the division of labor according to health, age, reproductive state, and task-specific skills; and 4) increased "down-time" for elaboration of domestic and symbolic activities.

Methods for Studying Late Onset Diseases of Aging. C. C. PLATO and R. M. GARRUTO. Department of Neurosciences, University of California San Diego, La Jolla, CA 92093 and Binghamton University, SUNY, Binghamton, NY, 13902.

The customary procedure in establishing the inheritance of a disease is 1) to ascertain through family studies whether the disease is familial; 2) if it is familial then to ascertain, through pedigree studies, whether the disease is inherited and 3) if it is inherited, to establish the mode of inheritance. There are various well-established methods through which these three objectives can be achieved, the details of which will not be discussed here. Rather we will address two of the problems one faces in studying the genetics of diseases with late onset.

One of them is that potential patients die before the age of clinical onset of disease, and the other is that patients usually die long before their offspring reach the age at risk. This interval may be as long as one or two generations or even longer. In an attempt to resolve these problems, we will discuss the methodological approaches used in studying two late onset neurological disorders on the island of Guam: amyotrophic lateral sclerosis (ALS) and Parkinsonism-dementia (PD). For determining the familiarity of these diseases, we established in 1958 a prospective case-control Registry consisting of all index patients, individually matched controls, and their respective first-degree relatives and spouses. The objective of the Registry is to ascertain whether relatives of patients are more likely to develop disease than those of the controls. The Registry was updated in 1963, 1978 and in 1998; and all new patients in both the patient and control panels have been identified and verified by neurological examination.

The results of our current 40-year follow-up indicate that patients' relatives have a higher risk of developing disease than those of controls. Likewise, in 1958, 1969, 1993, and 1998, family pedigrees of all index patients were constructed, as well as the complete genealogy of the village of Umatac, which has the highest incidence of these diseases. The 1969 analysis suggested a dominant gene with incomplete penetrance. The results of the 1993 analysis could not reject a two-allele additive major locus hypothesis. The 1998 pedigree analysis is currently under analysis.

Variance Dimorphism in Primates. J. MICHAEL PLAVCAN, Department of Anatomy, NY Coll. of Osteopath. Med., Old Westbury, NY 11568.

Understanding patterns of variation in extant species is important for interpreting the biological and taxonomic significance of variation in fossils. It has been suggested that trait variances are dimorphic across species. This "variance dimorphism" has been occasionally noted, but has only been evaluated for a few primate species in cranial characters. Two hypotheses have been put forward -- that males tend to be more variable than females, and that there are taxonomically diverse and significant patterns of variance dimorphism.

Craniometric data were gathered for 1576 specimens of 35 species, each represented by at least 15 specimens of each sex. Samples were composed of wild-shot specimens of known sex, representing the smallest possible geographic area to minimize interdemographic variation. Only specimens with completely erupted dentitions and closed spheno-occipital sutures were selected.

Data were evaluated using CVs of raw data, and ratios of variances of ln-transformed male and female data. Variability profiles of different species were also evaluated.

Within-sex CVs of most characters are low. Males are more variable than females in 54% of all comparisons. Within sexes, patterns of trait variance are relatively stable across species. Platyrrhines tend to show greater male variability, and cercopithecoids lesser. Otherwise, there do not appear to be taxonomically significant patterns of variance dimorphism.

These results show that character variation is stable across sexes and species. This implies that analyses of cranial character variation in fossils are not strongly confounded by either taxonomy or sex. Conversely, patterns of variance dimorphism probably have little potential for evaluating taxonomic hypotheses.

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**The aging human population: The potential impact of demographic changes over historical time on the genetic well being of our species.** S PLETCHER (Max Planck Institute for Demographic Research, Rostock, Germany) & RD HOPPA (Department of Anthropology, University of Manitoba, Winnipeg, Canada).

The long-term demographic evolution of human population structure can be reconstructed from both archaeological and genetic evidence. Archaeological



evidence has demonstrated the development of localized, regional populations with increasing population densities and genetic mixture over time. Genetic evidence has also contributed significant information, fueling discussions about the origins of modern human populations as well as demographic collapse among prehistoric human populations. Irrespective of specific issues related to these areas, a clear trend toward larger, more globalized, aging populations has been observed for humans. Explanations for the aging human population include dramatic reductions in age-specific mortality rates due to scientific and societal advancements.

There is evidence for extremely high deleterious mutation rates in hominids, and coupled with the reduced influence of natural selection in modern societies, the accumulation of mildly deleterious mutations may pose a serious health burden. In this paper we examine, in a historical context, the potential rising impact of the accumulation of mutations in contemporaneous human populations. We develop an interdisciplinary approach using anthropological data about changes in age-specific selection pressures over historical time, the frequency and magnitude of population bottlenecks, and the change in geographic structure of human populations, together with biodemographic data concerning the age-specific properties of new mutations. These data are used in the context of evolutionary genetic models of senescence to provide insight into the biological and societal implications of an aging population.

The kinematics of cursoriality: how patas monkeys differ from other primate quadrupeds. J.D. POLK Doctoral Program in Anthropological Sciences, SUNY at Stony Brook, NY 11794-4364.

Field observations, in combination with studies of limb morphology and body shape all suggest that Patas monkeys are the most cursorially adapted primate. Patas monkeys frequently use a long loping gait while on the ground and have been observed at speeds up to 55 km/h. Furthermore, morphological features such as elongated distal limb segments, relatively long, narrow trunk and elbow morphology indicating stability in extended postures, suggest that patas are adapted to relatively high-speed locomotion on terrestrial substrates. To date, the kinematic features that characterize patas gait have not been quantified. This study will describe the kinematic differences that exist between patas monkeys and other quadrupedal primates of similar size, and will highlight the consequences of differing limb proportions on locomotor performance.

Study individuals included one male and female patas monkey, one subadult male baboon, one adult female baboon and an adult male African green monkey. Variables examined included stride length, stride frequency, hindlimb and forelimb step length, stance duration, duty factor, shoulder and hip protraction and retraction, and elbow and knee flexion. Data were

collected using a Peak Performance 3D motion analysis system at the SUNY Stony Brook Primate Locomotion Laboratory.

The relatively long limbs and trunk of patas monkeys permits them to walk and run with longer slower strides than other monkeys moving at the same speed. The differences are subtle at slower speeds but more pronounced as speed increases. In addition, the angular excursion of hip and shoulder joints did not differ across taxa. This suggests that patas limb joints do not experience increased moments, and that their long limbs permit a more economical gait at high speeds.

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*Callimico goeldii* and *Saguinus*: Dietary differences between sympatric callitrichines in northern Bolivia. L.M. PORTER, Doctoral Program in Anthropological Sciences, State University of New York at Stony Brook, Stony Brook, NY 11794

Dietary data were collected during the first year-long comparative study of wild groups of *Callimico goeldii*, *Saguinus labiatus* and *Saguinus fuscicollis*. Group scans were taken every 5 minutes on one group of each species for 3-14 days each month from March 1997 - March 1998. If animals were eating during a scan, the food type was noted. Surprisingly, *C. goeldii* was found to consume large quantities of fungus throughout the year. Food type percentages of the total feeding records collected for *C. goeldii* were 28% fungus, 24% insects, 28% fruit, 2% vertebrates, 1% exudates, and 17% unidentified. In comparison *S. labiatus* was the most frugivorous: 65% fruits, 14% flowers, 6% insects, 5% exudates and 9% unknown. *S. fuscicollis* was also highly frugivorous and consumed the most exudates: 58% fruits, 16% insects, 11% exudates, 4% nectar and 10% unidentified.

During periods of low fruit availability in the dry season *Callimico goeldii* increased their intake of fungus, a resource that was rarely eaten by *Saguinus labiatus* and never eaten by *S. fuscicollis*. *S. labiatus* however, ate more nectar during this period of fruit scarcity, a food item that was not exploited by *C. goeldii*. Consumption by *S. fuscicollis* of exudates, nectar and arthropods all increased during the dry season.

Fungus consumption effects the ranging and association patterns of *Callimico goeldii* and may explain its "patchy" distribution pattern in the wild. *C. goeldii* has a home range six times the size of sympatric groups of *Saguinus*, and forms temporary associations with nine different mixed species groups of *S. fuscicollis* and *S. labiatus*. The difference in diet is one of the factors that define separate ecological niches for each of these species.

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Evidence of degenerative disc disease in Meroitic Nubians from Semna South, Sudan. W.E. POTTER, Department of Anthropology, University of New Mexico, Albuquerque, NM 87109

This examination of 179 Meroitic Nubians (circa 350 BC to AD 350) from Semna South, Sudan, contributes to research concerning the presence and patterns of Degenerative Disc Disease (DDD) in Africa. Differences in these patterns between the sexes suggest that a division of labor and other gender-based, culturally determined behaviors were present.

A gradation scale ranging from zero/marginal to four was employed to record lesions caused by herniated discs, compressed vertebral bodies, and osteophytosis. The intensity of each indicator in the cervical, thoracic, lumbar, and sacral regions was examined in order to determine patterns with respect to erect posture and curvature of the spine. The data were statistically analyzed using  $\chi^2$  and rank order correlation in order to determine the occurrence of degenerative changes with respect to age, sex, and biomechanics.

The incidence of DDD is correlated with increasing age, and males generally show a higher degree of involvement than females. In older age groups, males show a higher percentage of osteophytosis in the cervical region but a lower percentage than females in the thoracic region. Patterns suggest males carried heavy loads on their heads and women performed tasks involving stress in the thoracic vertebrae (e.g. bending over for food preparation, pregnancy, and carrying young children). Osteophytosis of the lumbar vertebrae was present in all older individuals.

Compression was relatively rare in the sample. Lesions caused by herniated discs only occurred in the thoracic and lumbar regions. The thoracic and lumbar regions also show higher degrees of compression, reflecting their weight-bearing function.

Sex and age differences in the frequencies of compressed vertebral bodies, herniated discs, and osteophytosis noted in the Semna South collection suggest that individuals practiced diverse cultural behaviors affecting their vertebral columns.

History, population structure, and time: new approaches for understanding biological change in the Americas. J.F. POWELL, Department of Anthropology, University of New Mexico, Albuquerque, NM 87131.

Ancient skeletons in the New World are described as morphologically distinct from modern American Indian and northeast Asian populations (Jantz and Owsley, 1997; Neves et al., 1999; Steele and Powell, 1999). This pattern has been attributed to the replacement of early "non-Indian" populations by later northeast Asian groups. Although multiple dispersal and replacement models have been in vogue since the 19th century, they suffer from typological and non-evolutionary thinking, and relying on historical events (range expansion) to explain patterns of change.

Model-bound approaches for assessing population structure from phenotypic data (Relethford and Blangero,

1990; Relethford and Harpending, 1994), as well as models that incorporate change through space and time (Konigsberg, 1990), can be used to examine differences resulting from range expansion, *in situ* evolution, or both.

I analyzed a series of Paleoindian (n=14), Archaic (n=419), and late Holocene (n=741) crania from the Americas to assess within- and among-group variability through time and space. Cranial and dental dimensions were centered by sex and adjusted for size, then used to generate Mahalanobis' distances, *F*-tests, and measures of within- and between-group variance. Mantel tests and Monte Carlo time series analyses were used to examine relationships between temporal, spatial, and biological variables.

Under the assumption of constant long-term effective population size (all relative  $N_e=1$ ), Paleoindians are distinct from modern American Indians. If effective sizes for Paleoindians were much smaller than modern samples (relative  $N_e = 0.30$ ), then Paleoindians do not diverge from American Indians. Regional time series provide evidence for linear trends in some craniofacial variables (GOL, XCB, ZYB) but minimal change in others (OBH, NLH). Partial correlation of temporal, geographic, and biological distances fit a models of isolation by distance once variables with significant trend were removed. These results indicate that historical events cannot adequately explain temporal and spatial changes in craniodental form during the past 12,000 years of New World prehistory.

Histomorphometric analysis of bone in common marmosets. R.A. POWER, C.P. JEROME\*, and S.D. TARDIF, Biological Sciences, Kent State University, Kent, OH 44242, and \*SkeleTech, Inc., Bothell, WA 98021.

Histomorphometry is widely used in biomedicine and basic science to measure bone morphology and estimate kinetic processes at the microscopic and cellular levels. Specific bone sites and compartments can be examined, and quantity, shape, and relative distribution of structural components can be determined. Our study investigated the effects of reproductive and life history variables on bone in the common marmoset monkey (*Callithrix jacchus*). For this presentation, emphasis is placed on methods and techniques used in our study, with illustration of applications to anthropological studies in living non-human primates.

Six lumbar vertebrae and 9 ilia were collected, postmortem, from 10 adult marmosets. Bone specimens were plastic embedded in methyl methacrylate, and thin sectioned (10  $\mu$ m) using an automated microtome. Cortical and cancellous bone measurements were made at 10X magnification using a light microscope, digitizing system, and Osteomeasure semi-automated bone histomorphometry software. Primary measurements were made by tracing the bone structure (using digitizing equipment) on a video-captured image of the thin section using the Osteomeasure software. Parameters, such as bone volume/tissue volume (BV/TV), bone surface/bone volume, trabecular thickness, trabecular number, and trabecular spacing, were derived by the software from primary measurements. These derivations allow determination of the quantity of cortical and cancellous bone relative to marrow or holes, as well as

structural integrity of the cancellous compartment in relation to bone quantity.

Applications are exemplified by providing questions and results from our study, such as the significant negative correlation observed between parity and vertebral cancellous BV/TV in females ( $n = 4$ ; Kendall's Tau =  $- .9$ ;  $p < .05$ ). This result is indicative of bone loss with increased number of reproductive events over the life span, and is independent of age. Other results illustrating applications of histomorphometry to questions concerning the relations among reproductive and life history variables and bone will be provided.

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The CT-scans of fossilized crania with encrustations removed allow morphological and metric comparisons of para-nasal sinuses. H. PROSSINGER<sup>1</sup>, L. WICKE<sup>2</sup>, H. SEIDLER<sup>1</sup>, G.W. WEBER<sup>1</sup>, W. RECHEIS<sup>3</sup>, G.B. MÜLLER<sup>4</sup>. <sup>1</sup> Institute of Anthropology, University of Vienna, Austria, <sup>2</sup> Department of Radiology, University Hospital Vienna, Austria, <sup>3</sup> Department of Radiology II, University Hospital Innsbruck, Austria, <sup>4</sup> Institute of Anatomy, University Hospital Vienna, Austria.

CT-scans of partially complete mid-Pleistocene fossils have helped elucidate unexpected affinities in the genus *Homo*. Here we present fossil crania that have had heretofore been limited in their analysis due to their encrustations: Steinheim, Bodo and OH 9. We present the techniques used to electronically remove the encrustations present in the endocranium and in the sinuses. We present the morphology of these sinuses and compare their volumes and their extent within the cranium with those of other mid-Pleistocene crania (Petrulona and Kabwe). We present a morphometric analysis of the shape of the sinuses after defining a set of suitable (sinus) landmarks. We also present the results of relating volumes to size (in a Procrustes sense defined by a set of endocranial landmarks) by looking at the ratio cubic root of volume to Procrustes size and using this ratio as a statistic in our analysis.

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When are browridges homologous?  
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A positional morphometric analysis of fifteen skulls from the Field Museum, Chicago, reveals that visual similarities

are no criteria for cladistic or genetic homologies. For example, two similar looking browridges can have different causes. Browridges are formed when supraorbital growth accommodates movements of the frontal bone. Supraorbital growth keeps the orbits intact. There are a variety of processes that cause frontal bone movement, several of which produce similar looking browridges. In general, genes program processes that produce shapes, but not the shapes themselves. Therefore, evolutionary homologies reside in processes, not products.

Chemical analysis of infant feeding practices from the Imperial Roman site of *Portus Romae*, Italy. T.L. PROWSE<sup>1</sup>, H.P. SCHWARCZ<sup>2</sup>, S.R. SAUNDERS<sup>1</sup>, L. BONDIOLI<sup>3</sup>, and R. MACCHIARELLI<sup>3</sup>; Department of Anthropology<sup>1</sup>, School of Geography and Geology<sup>2</sup>, McMaster University, Hamilton, Ontario, L8S 4L9, Canada; Pigorini National Museum of Prehistory and Ethnography<sup>3</sup>, Rome, Italy.

Information on infant care and weaning practices of the ancient Romans is derived largely from ancient authors, who have reported that the staple of the weaning diet was cereal. One of the limitations of these ancient texts is that they usually described the lifeways of the elite members of the population, thus comparatively little is known about the other classes of Roman society from these literary sources. The present research investigates the practice of weaning in antiquity using stable isotope analysis on a skeletal sample from the Imperial Roman necropolis of Isola Sacra. This cemetery was associated with the port of Rome, known as *Portus Romae* (1<sup>st</sup> - 3<sup>rd</sup> centuries AD), the population of which was composed primarily of middle-class merchants, traders, and their families.

Bone samples from 52 infants and subadults were analyzed for carbon and nitrogen isotope values; 32 of these individuals were under 3 years of age at death. The carbon isotope values show an enrichment in the diet beginning at approximately 1 year of age, suggesting the gradual introduction of new foods into the infant diet. By the age of 2 to 2.5 years the  $\delta^{13}\text{C}$  values stabilize at levels comparable to those obtained from adults in the Isola Sacra sample.

Further, the analysis of nitrogen isotopes show a gradual decline in  $\delta^{15}\text{N}$  values between 1 and 2 years of age, indicating the gradual removal of breastmilk from the infant diet around this time. After 2.5 years of age breastfeeding ceases completely, and the nitrogen values approach those of the adult samples. The utility of combining textual, iconographic, and skeletal evidence for the interpretation of infant feeding practices at *Portus Romae* is discussed.

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